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REPORT
OF THE
SELECT COMMITTEE
ON
VENTILATION,
APPOINTED BY
THE HOUSE OF COMMONS.
(BLUE BOOK, 1903.)

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1904.

MEMBERS OF THE SELECT COMMITTEE
ON VENTILATION,

APPOINTED BY

THE HOUSE OF COMMONS.

(1903.)

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Report
OF
The Select Committee
ON
Ventilation.

I.

(Reprinted from the "BUILDING NEWS," Jan. 8th, 1904.)

“THE question of ventilation is one that nowadays interests all classes of society, which really seems to be beginning to have a more intelligent appreciation of the necessity of pure air for the maintenance of health, and of the evil effects of foul air. A high authority (Parkes) says:—

‘Health is only possible when to other conditions is added that of a proper supply of pure air....Statistical inquiries prove beyond a doubt that of the causes of death which are usually in action, impurity of the air is the most important.’

Impurity of air the most important cause of death.

“In this connection, an analysis of the recently published report of the Select Committee on the Ventilation of the House of Commons (1903), with the views of others competent to express an opinion, should prove of value as embodying the latest and most authoritative ideas on the subject.

“There have been a good many Royal Commissions appointed from time to time to inquire into ventilation, particularly the ventilation of the Houses of Parliament, in which buildings a great variety of artificial contrivances have been tried at a considerable expenditure of the public money, but so far without any definite or satisfactory results.

Artificial Ventilation unsatisfactory

“It appears from the report that the fans for propelling air into the House do not satisfactorily perform the work they have to do, divers recommendations being made in respect to them. The hot-air extraction shaft in the clock-tower is also to be abandoned as inoperative.

Fans ineffective. "There are great complaints of the 'draughts' caused by the extraction fans in the divisional lobbies and the committee-rooms; in one room the chairman of committee insisting upon having the fans stopped as soon as he enters.

"These extraction fans, it is stated, have been put in at the suggestion of the Select Committee, and are, it is presumed, of the most improved pattern, though the results do not seem to be encouraging, as the Committee report in respect to them that complaints are made 'on the score of noise and draught.' "It is also stated that the ventilation of the smoking-rooms 'is by no means satisfactory.'

Intolerable draughts with extraction fans.

"The drawbacks to fan extraction appear to be the intolerable draughts they create, and the unequal distribution or extraction of the air, a small sirocco being set up in one part of a room whilst the air is stagnant in other parts. One report says:— 'Draughts existed in the upper levels of every room ventilated mechanically by extraction, while the halls of such buildings were generally full of draughts.'

Analysis of air misleading.

"The analysis of the air of the House is seemingly satisfactory, but it is significantly added:—

'This conclusion, obtained by means of objective tests, is not, however, confirmed by the subjective test of the Members' own feelings. It is the common experience of many Members that the air of the Chamber 'lacks freshness,' that there are some qualities possessed by it which lead to a stay for a length of time in the Chamber causing in the Members a lassitude and feeling of heaviness which tends to interfere with the due performance of their duties.'

"In another report on the ventilation of the House of Commons the following appears:—

Large volumes of air ineffective.

'When one considers the enormous volume of air, equal to ten times the cubic contents of the House of Commons, which is passed through it every hour, also that the elaborate tables of air analysis are apparently all that could be desired and yet the ventilation is so notoriously bad, it is clear that there is something very radically wrong with mechanical ventilation by impulsion, and that tables of analysis and of volumes of air passed through a building are not to be accepted as correctly indicating either the general purity of the air or the efficiency of the ventilation.'

Mechanical Ventilation by impulsion radically wrong.

"It seems that this feeling of *malaise* is usually experienced with artificial methods of ventilation, and is evidence of injury to health, demonstrating in an unmistakable manner that mechanically driving columns of air through or out of a building is not ventilating it, however powerfully it may be done.

Mechanically driving air through a building not ventilating it.

"The Committee says:—

'It will be desirable to bear in mind certain general principles of ventilation.... The density of air expired by man being the same as that of unbreathed air when raised to a tem-

perature of from 78° to 81° Fahr., or thereabouts, this expired air naturally ascends when the temperature of the surrounding air is below this range, and naturally descends when it is above it. Hence when, as is usually the case, the temperature of the air in a building is below 78° or so, ventilation from below upwards is assisted, and that from above downwards is hindered by the breathing effects of each individual in the building; and the larger the number of individuals the greater is the assistance or hindrance thus offered. Hence, other things being equal, natural ventilation may be said to be that which takes place upwards from below, or at least from the level of the heads of the persons present.'

Professor
Shaw.

"This accords with what has been expressed by an earlier Royal Commission:—

'Whilst the air is in the lungs,' say the Commissioners, 'it acquires so much heat that it becomes specifically lighter than the surrounding air, and rises above our heads. The heated air which passes upwards should pass away... For the ventilation of rooms exits should be provided for the spent air near the ceiling... The method of low ventilation (exits near the floor) should be avoided on various grounds.'

Royal Com-
missioners
condemn
downward
ventilation.

"The report of the Committee proceeds to deal with the 'Plenum' system, ventilation by fan propulsion, electrically or engine driven:—

'Taking No. 1, the "Plenum" system,' says the report, 'the flow is determined simply by pressure at the inlet, and the air makes its exit below the breathing level.

'These features would alone lead the Committee to hesitate in recommending that the present scheme should be exchanged for the "Plenum" system. They are confirmed in this decision by the following considerations—

"Plenum"
system dis-
approved of.

'As was stated above, an essential condition of the system is that all windows be kept closed, and that no doors be left open for a longer period than absolutely necessary for entrance or exit. The Committee believe that this condition would be very strongly objected to by Members. Moreover, the Committee learn that in buildings in which the system is in use, the very regularity, it may be said the very monotony of the supply, aided perhaps by the psychological influence of not being able to open a window, produces an unfavourable effect on those remaining in the building for any length of time. These speak of the air as "tiring" or "oppressive," and say they feel "that they want to open the window in order to get a little fresh air." Making every allowance for the play of prejudice, the testimony thus given does seem to the Committee to militate seriously against the system, and they cannot recommend that it should be adopted.

Air "tiring"
and "oppres-
sive" with
"Plenum"
system.

Mechanical
downward
ventilation
" unsatis-
factory."

' Passing to system No. 2 [also mechanical], with the intake at the ceiling and the outflow by the floor, this differs from the "Plenum" system chiefly as regards the distribution of motive power. It contravenes (ii.) and possesses no advantage as regards (iv.), and it is doubtful whether it would satisfactorily comply with (i.) and (iii.). Moreover, the system was in early days adopted in the Chamber, and given up as being unsatisfactory. The Committee cannot recommend its adoption.'

Hot - air up-
cast Shafts
inoperative.

" These mechanical systems do not apparently meet with the approval of the Select Committee, and it is to be hoped that it may succeed in securing the ' more perfect fan,' which it is suggested should be tried—when found—as a substitute for the existing hot-air upcast shaft in the clock-tower, that somewhat antiquated and out-of-date method of extraction being condemned as inefficient and expensive. Judging from the results of the experiment which the Committee has already made with the latest construction of extraction fans, these appliances, when used for extraction, would seem to be no more satisfactory than when employed for propulsion, and it is conceivable that their extension, as is proposed, to the Debating Chamber may meet with no greater success than has hitherto attended all previous efforts to ventilate the Chamber with artificial arrangements.

Objections to
open window
ventilation in
cold weather.

" The objections to open windows when used as a means of ventilation in cold and stormy weather are admitted ; but barbarous though such a method may be when employed under those conditions, it would seem, according to the Committee, could it at all times be employed, to be preferable to ' Plenum ' ventilation, which, though doubtless very captivating in theory and to the inexperienced, has been shown in practice as applied to different classes of buildings to be even more unsatisfactory and unhealthy than the hot-air extraction shafts in vogue in the early days of ventilation, and of which type the shaft in the clock-tower, now condemned by the Committee, is a belated survival.

Failure of
" Plenum "
ventilation.

" Referring to one of the latest applications of the ' Plenum ' system, or fan propulsion, to a large building in Birmingham, it was stated at a meeting of the Royal Institute of British Architects, that :—

' It would become a very big question whether the " Plenum " system would not be taken out of those buildings, and something of a very different nature put in.'

" It is also said in respect to this building, that :—

" Indefinably
depressing
effect " with
" Plenum "
system.

' A feeling of oppression existed which did not meet with the entire approval of the Visiting Staff, as exercising upon them an indefinably depressing effect, and that the atmosphere was close and lacking in freshness.'

" This system has not been any more successful in a similar

building in Glasgow, judging from the published reports of tests and statements of certain of the staff.

"A paper on 'Plenum' ventilation as applied to a hospital in Belfast was read a week or two ago before the Royal Institute of British Architects. In the course of the discussion, a distinguished medical scientist (Dr. Christopher Childs) said :—

'In many "Plenum" installations he had inspected, there had seemed to him grave defects in the relative positions and sizes of the inlets and outlets, and it seemed to him that no definite principles had been laid down as to the most important details. He was not sure that it afforded fresh air for hospitals and schools. They all recognised the necessity for a full supply of pure air. It was easy to test the atmosphere and ascertain the relative proportion of carbonic acid gas in a volume of air, and also to count the microbes ; but hitherto analysts had failed at one point—in showing them whence came the invigorating qualities which they all recognised as present in fresh air. These health-giving qualities seemed to him to be lacking in air pumped into a building under a "Plenum" system, and to be present in methods of natural ventilation. The value of fresh, not filtered or pumped, air was obvious in the treatment of cases of phthisis, and all recognised its exhilarating effects.... He would not allow that it (the "Plenum" system) was the best for hospitals, as patients needed the stimulus of absolutely fresh and frequently changed air.'

Where
Analysts
fail.

"A well known London architect (Mr. A. Saxon-Snell), endorsed this opinion, saying that :—

'He and others believed it to be, so far as they had investigated it, a *huge mistake*.'

"Plenum"
Ventilation
"a huge mis-
take."

"There would seem to be a lack of scientific treatment in the designing and application of these mechanical systems, and an imperfect knowledge of the natural laws which control what is called 'ventilation,' that must militate against ventilation as an applied science in the mind of the layman, by shaking confidence, and engendering a feeling of distrust which is to be deplored, as much harm and misunderstanding may arise therefrom. Truly, a little knowledge in matters such as these is indeed 'a dangerous thing.' Parkes says :—

'Ventilation is a science, and it requires the study of a lifetime to master properly all its intricacies. The greatest engineering skill is necessary in the arrangement of tubes and the supply of fresh air.'

Ventilation a
science.

"The Metropolitan Asylums Board, which is advised by eminent scientists, does not employ mechanical ventilation, the hospitals under its jurisdiction being satisfactorily ventilated by natural means, and the official reports of the results obtained with the 'Boyle' system form an object lesson as

Natural Ven-
tilation effec-
tive.

to what may be achieved with a natural method of ventilation scientifically applied.

“This system is favourably referred to in a number of Government reports, and from published accounts it would appear that buildings of greater magnitude and of a more difficult character than the Houses of Parliament have been successfully ventilated with it. Sir Douglas Galton doubtless spoke from the depth of his great experience when he said :—

Sir Douglas
Galton
approves
Natural Ven-
tilation.

‘ It is far better to trust to the ventilation of nature—natural ventilation—than to the artificial pumping in of air ’—a dictum which is endorsed by an equally high authority, Sir Henry Burdett, who says :—

Sir Henry
Burdett
recommends
Natural Ven-
tilation.

‘ Having regard to the temperate character of the British climate, we have yet to be convinced that it is desirable or necessary to introduce artificial ventilation into our hospitals. . . . At Guy’s Hospital (new building) the artificial system can be compared with the natural system in the older wards, and the result of the comparison certainly does not make for the superiority of the former method.’ ”

Report OF The Select Committee ON Ventilation.

II.

(Reprinted from the "BUILDING NEWS," Jan. 15th, 1904.)

“[LIEUT.-COLONEL D. BOSWELL REID (son of the Colonel Reid, late Dr. Reid, who designed a system of ventilation for the Houses of Parliament), in giving his evidence before the Committee, said :—

‘I was very much astonished to find that the arrangements were entirely reversed in many respects from the condition in which my father left them in 1852; and I was not at all astonished to see in the papers certain language which did not seem to speak very highly of the condition of affairs as to the ventilation here.... The special defect is this: in my opinion a properly ventilated chamber should ventilate itself *naturally*.’

Natural Ventilation approved.

“Referring to the hot-air aspirating shaft in the clock-tower as a means of extraction, Colonel Reid further said :—

‘It is a very expensive way, and, I should say, a very unsatisfactory way.... It is absurd and ridiculous, and contrary to all science and common sense.’

“This opinion was endorsed by Professor W. Napier Shaw, head of the Meteorological Office, who advised that this hot-air shaft should be disused as inefficient and out of date, and it has been abandoned accordingly.

“From the complaints made by the Members in respect to the ‘noise and draughts’ caused by the new extraction fans fitted experimentally by instruction of the Committee to different parts of the House, it would appear as if the question

Complaints re extraction fans.

of extraction has not yet been satisfactorily solved, and according to the report, it is proposed to remove these fans from their present positions, and try them elsewhere to see if there is any improvement, which would appear to be somewhat hopeless.

Cold draughts with extraction fans.

"Extraction fans may be all very well in hot weather when a draught from any source is sometimes acceptable, though in warm weather there is nothing to equal an open window, which may then safely be resorted to, and it has the additional advantage of being costless: but it is a very different thing in cold weather, when, it is safe to say that, in at least nine cases out of twelve where extraction fans are used, they will be found to be out of operation, as people simply *will not* put up with cold draughts in such weather, especially the arctic whirlwind usually experienced in the vicinity of an extraction fan; so that, during the winter months, when, owing to doors and windows being kept closed, special means for ventilation are most required, extraction fans cannot be employed except at a sacrifice of comfort and the risk, nay, certainty, of catching cold.

Would rather be stifled than killed with extraction fans.

"The Council Chamber of the Bristol Corporation may be cited as a case in point, where the city fathers have had to ask the Mayor's permission to wear their hats as a protection against the 'insufferable draughts' caused by the new electric extraction fans. One councillor pathetically pleaded to have the fans stopped, protesting that he 'would rather stifle than be killed by these terrible draughts.'

"This would appear to be the general experience where electric extraction fans are employed, particularly in cold weather.

"The following extracts from a report on the ventilation of the Houses of Parliament speak for themselves as to fan propulsion.

Mechanical Ventilation by propulsion condemned.

'I never yet knew of a system of propulsion, pure and simple, that effected an efficient and satisfactory ventilation of any large building.... So long as architects employ the "Plenum" system or propulsion pure and simple, colossal buildings like the Houses of Parliament, the London Law Courts, the National Liberal Club, etc., will continue to be notoriously badly ventilated in every sense of the term.

'This trouble of inefficient ventilation in large legislative buildings—notwithstanding the enormous amount of fresh air that can be passed through them sometimes "without ventilating them"—is not at all confined to the Houses of Parliament in this country.'

It has been said that:—

The Houses of Parliament have been the field of various successive experiments on a large scale, each of which in

turn was supposed would completely succeed in rendering the legislative chambers places of pure air.

‘They have all, however, proved *disastrous failures*.’

Artificial
Ventilation
a disas-
trous
failure.

“The Select Committee having recorded, in common with previous committees, its disapproval of ‘Plenum’ and kindred methods of mechanical ventilation, which it ‘cannot recommend should be adopted,’ and as neither the propulsion nor extraction fans, nor the hot-air upcast shaft in the tower appear to be satisfactory, it will be interesting to note what other plan may be resorted to in this the latest of the many attempts to efficiently ventilate the House of Commons artificially, and which, so far, have proved abortive and worse than useless.

“The Committee has clearly pointed out the evils arising from the present method of propelling, by means of fans, hot air into the House, to which is in part attributed the ‘lassitude and feeling of heaviness experienced by the Members, which tends to interfere with the due performance of their duties.’

Evils of hot-
air supply.

“Open windows are also apparently not to be thought of, as it is stated they could not be employed in cold weather on account of the draughts and other annoyances, which the Members would not stand.

“A Royal Commission on the Ventilation of Schools appears to have arrived at the same conclusion, stating, in regard to open windows, that :—

‘In those cases in which the ventilation was effective the temperature of the dormitory would follow closely that of the outside air, and would not exceed that of the outside air by more than about $2\frac{1}{2}^{\circ}$.’

“With the thermometer at freezing point plus the cold draught, such a temperature in an occupied room would be unbearable, and yet, as is pointed out, that is what open-window ventilation practically represents during certain periods of the year, and it cannot therefore be relied upon as a constant, satisfactory, or always safe means of changing the air.

Objections to
open-window
Ventilation
in cold
weather.

“It would seem, from the unanimity of their reports, that Royal Commissions on Ventilation have a rooted objection to open windows in cold weather, ‘Plenum’ ventilation, and hot-air exhaust shafts.

“One Royal Commissioner (Dr. Armstrong) denounces the ‘Plenum’ system or fan ventilation by propulsion in the strongest terms, saying :—

‘Anything more pernicious I cannot imagine....Such a system is abominable.’

An abom-
inable
system.

“Another Royal Commission also condemns it in no uncertain language :—

‘In one hospital we examined,’ say the Commissioners, ‘which was ventilated by one of the most elaborate

Royal Commissioners condemn the "Plenum" system.

apparatus ("Plenum") we have anywhere seen, and which professed to supply between 4000c.ft. and 5000c.ft. of air per bed per hour, we found the atmosphere of the wards stagnant and foul to a degree we have hardly ever met with elsewhere. We at once pointed out this circumstance. An inquiry was immediately instituted, when it appeared that one of the valves of the supply pipe had been tampered with, for no other reason, that we could perceive, except to save fuel by diminishing the quantity of warm air supplied to the sick. The ventilation in this case was worse than a delusion.'

'Sir Douglas Galton makes the following pregnant remarks in 'Hospital Construction':—

Sir Douglas Galton condemns Artificial Ventilation.

'The writer has visited, on several different occasions, three of the important hospitals in Europe and the United States of America in which the ventilation depended on propulsion, and on every occasion the propulsion happened to be out of use for the time....

'The author visited a hospital recently in which the ventilation was by propulsion. The amount of fresh air which was entering the wards was stated to be at the time at a rate of over 5000c.ft. per patient per hour, and yet there was a distinct feeling of relief and freshness on passing from the ward to the open air....

'Experience would seem to justify the hesitation which has been felt with respect to artificial ventilation.'

'Professor R. H. Smith, referring to 'Plenum' ventilation, says:—

'The down system can never supply really pure air to be breathed by the lungs. The exhalations of the human body are, as they issue, so warm that they must perforce immediately rise. Therefore, if the supply of fresh air comes from above, it can only reach the nose and mouth by driving down with it and mixing with these foul exhalations, and there is unquestionably nothing to breathe except this polluted mixture.'

"Plenum" ventilation "a menace to health."

'This system is of American origin, but is now condemned as 'a menace to health,' and practically discarded in the United States.

'In the face of all this, no other conclusion can be come to than that the repeated failures to effectually ventilate not only the Houses of Parliament, but other public buildings, must be ascribed to a too blind adherence to mechanical and other artificial arrangements, and to ignoring the claims of natural means scientifically adapted to the special requirements of the buildings to which they may be applied, and which there is the strongest evidence to show, have been com-

pletely successful in buildings of the largest size, and where artificial methods had been tried and failed.

Natural Ventilation pronounced to be the best.

“No higher testimony to the superior merits of natural ventilation over all other methods could be given than at the last Paris Exhibition, when the different juries, composed of scientists, engineers, medical men, architects, and others, occupying the highest positions in their respective professions, unanimously adjudged a natural system of ventilation (Boyle's) to be the best, and accorded it the palm.

“At the London Ventilation Competition the result was the same: a natural system (Boyle's), after the most searching investigation and strictest tests, being pronounced to be the best by the high and well known authorities who formed the jury.

“On both these occasions all the best known mechanical and other artificial systems in the world were represented.

“With these decisive and incontestable facts before us, there is, as Dr. Fardon, Chief Physician at Middlesex Hospital, says, absolutely ‘no excuse for adopting an artificial method of ventilation,’ and who further says: ‘I have inspected many mechanical systems of ventilation, including those at the Houses of Parliament and the Law Courts, but have never seen one that was approved by those who used it.’

“No excuse for Artificial Ventilation.”

“It is almost incredible the ignorance that prevails in connection with these mechanical systems and their application, and the lack of even the most elementary knowledge of the principles of ventilation and of the natural laws involved. Colonel Reid, continuing his evidence before the Committee, said, in reference to his inspection of the ‘Plenum’ system at the Houses of Parliament, Victoria, and which is also said to be a failure:—

‘When I went there I found the ventilation superintendent, a man who was disposed to teach everybody what he knew nothing about himself. I asked him what were those peculiar things which I saw, like spittoons, between the Treasury Bench and the Table of the House, and he gave me a short lecture on ventilation, in which he said: “You know, carbonic acid being heavier than air, the carbonic acid separates itself from the expired air at the mouth, flows down, and is sucked down by these holes.” I put on my hat and went out.’

Ventilating spittoons.

“One would have thought that in these days of higher education and sanitary progress, even a schoolboy would know that, as Professor Woodbridge so lucidly explains it:—

‘The carbonic acid gas yielded by respiration from the lungs and transpiration through the skin is as thoroughly diffused in the warm air currents rising from the body as is the same gas made by a candle or gas flame in the air currents ascend-

Carbonic acid gas expired from the lungs does not fall.

ing from those flames. That gas when once diffused in air can, because heavier than air, no more settle downward out of the air, and occupy the lower stratum of a room than the salt, because heavier than water, can settle out of the sea to its bottom.'

"As has been truly said :—

Change in
ideas regard-
ing venti-
lation.

'The overwhelming testimony which now exists against the utility of mechanical or artificial ventilation in any form and in favour of natural ventilation intelligently and scientifically applied has led to a marked change in the opinions once held by many with regard to the comparative advantages of the two methods.' "

Report

OF

The Select Committee

ON

Ventilation.

III.

(Reprinted from the "BUILDING NEWS," Jan. 22nd, 1904.)

“PROFESSOR SHAW, continuing his evidence before the Committee said:—

‘Before going on to express my opinion about the application of the system of ventilation to the particular case of the House of Commons, I would like to point out one circumstance which seems to me to be extremely important, and is sometimes overlooked—that is to say, that each individual in a room is a source of warmth to the air which surrounds him, and he does, as a matter of fact, distribute the air largely for himself. He warms the air that surrounds him; it rises above his head, and its place is supplied by cooler air from somewhere or other....He is himself a ventilating machine....I think it is an extremely satisfactory way of assisting the automatic distribution of air which the individuals themselves produce.’

Professor Shaw explains the efficacy of natural or “automatic” ventilation.

“Professor Shaw here clearly defines one of the primary and most important elements in natural or automatic ventilation.

“Sir Douglas Galton, dealing with this question of ‘self’ ventilation, says that if the fresh air supply could but have free access to each person in an assembly, and the warm columns of air arising from the body and expelled from the lungs were continuously drawn off at the roof, to where they naturally ascend, and not permitted to return to be rebreathed, 100 cubic feet of air per hour per person would be amply sufficient, and ideal ventilation would be achieved. Now anyone who

“Self” or Natural Ventilation, the ideal ventilation.

knows what a scientific natural system of ventilation really is, is aware that those conditions are precisely what it secures.

Mechanical ventilation
"a positive evil."

"As showing that mechanical ventilation may prove a positive evil, the following extracts from an account by a well known sanitary architect (Mr. G. H. Bibby) of its application to Claybury Asylum, are instructive.

'I now give the history of the artificial ventilation applied to one of the largest and most costly buildings, where every effort was made to carry it out with good results, but without avail.

'The Claybury Asylum was erected by the London County Council at a cost exceeding half a million, and accommodates more than 2000 patients.....

'The asylum was warmed and ventilated throughout on the "Plenum" system.....

'It was reported to the Asylums Committee that it was *hoped* that the "Plenum" system, by which the asylum was heated and ventilated, would work more successfully and economically than in the past winter.

Commissioners in Lunacy condemn mechanical ventilation as "dangerous."

'The Commissioners in Lunacy complained in their report, that the air-inlets were badly placed, and that the system of ventilation used was dangerous.

'The London County Council Asylums' engineer reported to the Council that "the principle of this system causes very large working expenses compared with other methods, whilst its magnitude will entail an expenditure for upkeep unknown in our other asylums. Very excellent results are necessary to warrant such large expenses."

Great cost of mechanical ventilation.

'...Such a periodical expenditure would not have been necessary in the case of a well arranged natural system of ventilation!'

Mechanical ventilation
"vexatious and unreliable."

"This artificial system of ventilation appears yet later not to have satisfied the Commissioners in Lunacy.

'....The Medical Superintendent reported as follows: "The system is a vexatious and unreliable one....Everything is apparently done to control this system....No reliance can be placed upon it."

'....The Claybury Asylum Sub-Committee found matters to be so bad that they reported to the Asylums Committee that the system of ventilation was probably the cause of much sickness.'

"Plenum" ventilation
"a mistake that may be followed by very grave consequences."

"Referring to the 'Plenum' system, one of our leading hospital architects (Mr. Keith D. Young) says:—

'There is a case to which I have before alluded, which goes to prove that mechanical ventilation can become a positive

evil. The application of such a system as this, however carefully contrived, to the wards of a hospital is, in my judgment, a mistake, and a mistake that may be followed by very grave consequences. Quite apart from the fact that warming by hot air is neither natural nor pleasant, the adoption of such a system, involving, as it does, the absolute closing of all windows, and the construction of long channels and shafts for the conveyance of the air, is entirely opposed to all that experience has taught us in hospital hygiene. Neither is there any solid foundation of fact to show that what is called natural ventilation has failed in such a way as to call for its abolition. On the contrary, there is abundant evidence to prove that the results obtained in hospitals ventilated by natural means are better than in those provided with mechanical appliances and with sealed windows.'

Natural ventilation found superior to mechanical.

" Indeed, it may be said that no architects of great repute or position have relied upon mechanical ventilation, and in respect to this Sir Douglas Galton observes :—

' The system of propulsion for hospital ventilation has not found general favour with hospital architects or managers in this country.'

" Prof. Shaw, being invited by the Committee to state his views on the ' Plenum ' and kindred mechanical systems, said :—

Prof. Shaw condemns the " Plenum " system.

' Making a general descending current over the house means mixing the used air with the fresher air and bringing the mixture down to the floor of the House, and passing it over the Members. In so far as that point is concerned, the suggestion seems to me to be worse than the present system. The air supplied, unless the amount were proportionately increased, would be less fresh when it reached the floor than the air is at present, in consequence of the fact that the products of respiration and so on have to go upwards in the first instance, and to bring them down again would mean bringing them down past the Members. The " Plenum " system seems to me to have the same objection, because that depends upon introducing the air near the ceiling and taking it out near the floor. And it has also this additional disadvantage, in my mind : that it involves the closing of all openings except those that are intended for the purposes of the system ; so that the windows must be kept closed and the doors must be kept closed, or, in case of communication with the outside, it must be by air locks ; that is to say, by double doors. I think that that system, which involves somewhat rigid arrangements for the distribution of air would be found so irksome to Members of Parliament that it is not desirable to introduce it.'

Products of respiration re-breathed with Plenum ventilation

" Professor S. Homer Woodbridge, in a report to Congress on the ventilation of the Capitol, Washington, also condemns this system, saying :—

Prof. Wood-
bridge con-
demns the
" Plenum "
system.

' The air in contact with the body or clothing, or expelled from the lungs, made moist and warm by the body's heat and vapour, rises in a current which has a far more rapid rate of upward movement than any descending rate which can possibly be given to the mass of air ventilating a hall. . . . In downward ventilation the air breathed by floor or gallery occupants must, therefore, necessarily be that of the ascending currents of vitiated air reversed by and diluted in the descending mass of air used in the downward movement. In well planned upward ventilation, the individual currents rise to the ceiling and there escape, leaving the floor occupant in the cooler and purer air supplies at the floor, and untainted by the vitiated air which rises out of and away from it. . . . The effectiveness of properly arranged upward ventilation of audience halls is demonstrated in the most recent work of this kind in two theatres and a music hall in Boston.'

Effective-
ness of
natural up-
ward venti-
lation
demon-
strated.

" The tables giving the results of tests made by Professor Woodbridge in a large number of public buildings are of the most conclusive and convincing character, and demonstrate beyond all cavil the immense superiority of the natural or upward method over the ' Plenum ' downward plan, which is also strikingly demonstrated to be highly injurious to health.

Failure of
" Plenum "
downward
ventilation
at the
German
House of
Parliament.

" The failure of the ' Plenum ' downward system at the German House of Parliament, Berlin, and the substitution of upward or natural ventilation, is historic in the annals of ventilation, and the following extracts from the report of the eminent American engineer, Mr. David Grove, who carried out the work, are very instructive. After two years' experience with both methods, the engineer reports, under date of January 3rd, 1898, as follows (addressed to K. Hinckeldeyn, Imperial Director of Public Buildings, Berlin) :—

No system
so good as
upward,
or natural
ventilation.

' In reply to your inquiry of December 25th last, I have pleasure in informing you that the practical working of the heating and ventilating in the new German House of Parliament is such as I felt sure would be the case when preparing the plans. The experience gained during the forty years of practical attention which I have given to the subjects of heating and ventilating has proved to me that no system is so good as the up-draught system, this being a natural one, and, if properly arranged, in every way effective.

' When I planned the heating and ventilating of the building in question, it was stated in the programme that down-draught ventilating must be employed, and that is the

reason why I planned that system. At the same time, however, I prepared plans for a system which I felt convinced would be far superior—namely, for upward draught—and the practical working of this principle is in every respect satisfactory.

‘When experiments have been made with down-draught, the air in the room has been found to be very oppressive, especially in muggy weather.

Air “very oppressive” with “Plenum” downward ventilation.

‘...It has for a long time been a fully settled matter in my mind that the only way to really ventilate a room is to let the air take its natural course. During the whole of my experience I have never yet seen a room in which the down-draught system is used where the ventilation has been a perfect one; and, of course, in any rooms where gas is burned, such a system is entirely out of the question.’

“Professor Smith says:—

‘...The commonly adopted basis of calculation of so many cubic feet of space in each room per person meant that the object aimed at was the slowing down to a standard time-rate of the vitiation of a stationary quantity of air. From this idea was derived that of supplying per hour between 30 and 200 times as much as was actually inhaled by the inmates of the room. The true idea of perfect ventilation is evidently to inject and extract only a moderate excess—say five to ten times as much—over that actually used, and to do so in such a manner that (1) the exhalations do not mix with the fresh-air supply, and (2) the inflow is properly diffused, and does not pass direct to the outlets in merely local currents or draughts.

Prof. Smith approves upward natural ventilation.

‘The only ideally perfect ventilation consists in inducing a regular up-current from a level below that of the human head up to the extraction outlets at the ceiling. Under this system the bulk of fresh air required to be admitted is immensely reduced, as is also the expense of warming it to any degree considered desirable.’

Upward natural ventilation “the only ideally perfect ventilation.”

“The following report of proceedings at the Congress of the Sanitary Institute denotes the feeling that prevails among sanitary scientists in respect to mechanical ventilation, the ‘Plenum’ system being under discussion.

‘We have a striking instance at the Congress of the Sanitary Institute, of how an assembly of scientific experts, having an intimate practical knowledge of ventilating systems and their respective values, unanimously condemned what they knew to be a dangerous system, but which non-experts, having no, or at most but a superficial, knowledge of ventilating arrangements, impressed by the working of elaborate machinery, accept as efficient.

Mechanical ventilation condemned at the Congress of the Sanitary Institute.

Natural ventilation approved at the International Congress of Hygiene, and Congress of the British Institute of Public Health.

‘The system was condemned as a “retrograde step, which the Sanitary Institute ought not to endorse; that all mechanical arrangements of the kind were apt to get neglected and fall into disuse, and that no figures had been given to show the actual economy of the scheme....”

‘The decision at the Congress of the Sanitary Institute against mechanical and in favour of natural ventilation confirms the opinions approved at the International Congress of Hygiene, Budapest, and at the Congress of the British Institute of Public Health.’

“‘Plenum’ downward ventilation was tried experimentally at Glasgow University under direction of Lord Kelvin and the University authorities, but was finally abandoned as inefficient and unhealthy, and replaced with natural ventilation.

Bacteria bugbear exploded.

“Advocates of mechanical systems profess to attach great importance to the removal of all bacteria from the air, and show wonderful tables of analysis. Perhaps this, to some extent, accounts for buildings so ventilated being generally so unhealthy. Sir Michael Foster, chairman of the Select Committee, when giving his evidence, rather explodes, as follows, the bacteria ‘bogey.’

‘The Committee would like to know whether it is dangerous to filter air too free from non-pathogenic germs which may have the property of attacking and destroying the pathogenic germs when they come into contact?—I should say in the first place, it is exceedingly improbable that we should be able to remove all the bacteria; there will always be some left; and, in the second place, the removal of the pathogenic bacteria will take place *pari passu* with the non-pathogenic so that the diminished bacterial supply will be equally good or equally bad as the original supply.

‘Do the non-pathogenic germs do people any harm when breathing? If they are not pathogenic, what harm can they do?—We have no evidence that they do harm at all so long as they are not pathogenic.’

Injurious effects of Artificial Ventilation.

“The following is also interesting in respect to the injurious effects of artificial ventilation. Professor Shaw being examined:—

‘There are very many qualities of air, in spite of our chemical knowledge, that we know little about at present?—That is perfectly true.

‘And we may be altering these very considerably in our artificial apparatus?—Yes; that is a very serious consideration.

‘But the difference between artificially supplied air and the natural air may be due to occult qualities which at present are beyond our knowledge?—Unknown, certainly.

'Is it not better to avoid hyper-purification of the air which causes lassitude and oppressiveness?—If that is the result in the end, it would be.'

"It was also stated by a member of the Committee that :—

'A colleague of Mr. Dillon, a medical man, used to complain very bitterly of the condition of the air, which he said was making his hair drop off. To use his own phrase, "Making his head as bare as a billiard ball."'

"Head as bare as a billiard ball."

"This is not a very high testimonial to the quality of the air supplied to the House by the elaborate and costly artificial system in use, and does not say very much for the healthiness of fan ventilation.

"Cocoa fibre, manilla cord, and glass tube water air screens employed in 'Plenum' systems were disapproved by the Committee as objectionable for various reasons. Copper wire gauze and scrim cloth or canvas filters, the forms usually employed with a natural system, were recommended to be adopted.

"Plenum" air screens disapproved of.

"As a significant instance of the change that is taking place in ideas regarding the respective merits of artificial and natural methods of ventilation, the results of the new Odessa Hospital competition are distinctly instructive, this hospital being one of the largest in Russia, if not in the world.

"As the efficient ventilation of the hospital was considered to be of the first importance, very special attention was given to the subject, the leading ventilating engineers in Europe being invited to submit plans. There were, it is stated, thirty-four schemes in all sent in, nineteen of which were from this country, four being American systems. All were mechanical with the exception of one, which was a natural system. The decision arrived at in respect to these plans was that a mechanical system should be adopted. It was resolved, however, that before selecting any particular plan from amongst the number submitted, a committee should be appointed, consisting of engineers, architects and others qualified to judge, to investigate into the merits of the respective systems, as applied to buildings in different countries. This committee commenced its labours in Odessa, where several public buildings are mechanically ventilated. It seems that in none of the buildings inspected was the mechanical system found to be in operation, though of the latest construction, the committee being informed in each case that the ventilation was better and less objectionable without it, and it had therefore been disused. The committee paid a visit to this country and made exhaustive investigations into the different systems in use here, including the natural system. Upon the completion of their investigations, the report of the committee was laid before the

Instructive lesson in ventilation.

Judges appointed to investigate.

Judges decide in favour of Natural Ventilation.

Municipality of Odessa, who had also received reports from other quarters, the result being that it was unanimously resolved that mechanical ventilation should *not* be employed, and that the natural system (Boyle's) be adopted.

“This certainly speaks volumes as to which of these systems, the natural or the mechanical, was found to be the best when the test of actual experience was applied to them by competent and unprejudiced judges.”

Report

OF

The Select Committee

ON

Ventilation.

IV.

(Reprinted from the "BUILDING NEWS," Jan. 29th, 1904.)

“ONE of the greatest evils of mechanical or ‘Plenum’ ventilation is the overheating of the air supply, which with this system has also to heat the building, as the air gets burnt and loses a portion of its oxygen, owing to the temperature of the warmed air requiring to be raised for heating purposes beyond what is either comfortable or healthy for breathing, causing a feeling of oppression and lassitude, owing to the insufficiency and attenuation of the oxygen in the overheated and highly rarefied air. The best authorities are now agreed that the heating and the ventilation of a building should be dealt with separately.

Evils of over-heating air supply.

Heating and Ventilation should be kept separate.

“In connection with this the Committee report :—

‘The Committee received valuable evidence from Dr. Shaw as to the alleged enervating and other undesirable effects of air artificially warmed.....It is evident from what has been said above that the lack of “freshness” in the air of the Chamber, which seems to be the cause of the feelings of lassitude produced by a lengthened stay in the Chamber, cannot be attributed to those chemical changes in the air which are easily recognised by primary methods or to any excess of micro-organisms ; it appears to be due to some recondite causes not as yet accurately determined, which seem to be always met with when air is supplied to a room by artificial means, and especially when it is heated.’

Lack of “freshness” and lassitude due to Artificial Ventilation,

"The following is the gist of Professor Shaw's evidence :—

'One may suppose possibly the lassitude or discomfort that arises in many cases from using artificially warmed air may be due to one or other, or to a combination of these four causes, namely: (1) The inadequacy of supply; (2) the dryness of the air after being artificially warmed; (3) the effect of the heating surface in producing actual deterioration of the air; and (4) the deadly uniformity of the supply. I have used a strong adjective for a definite purpose....

'Of course, I have no means of estimating the discomfort of uniformity, but I should expect that it is really an important element in the case of warming by hot air. With naturally ventilated rooms that feel fresh the supply is what I may call "streaky."

'.... Transient variations in the temperature of the supply might very possibly induce a feeling of freshness that is not to be attained under perfect uniformity.

'.... With a natural system of ventilation the variations exist, but are not under control; in other ventilation systems they do not exist.'

'As to this monotony that you speak of,' "said a member of the Committee," 'the effects of it may perhaps be seen in the "Plenum." You know the full "Plenum" system where the supply is exceedingly uniform; but those who use that system a great deal—those who, for instance, live in a room that is absolutely ventilated by that system—only complain of the air being oppressive and giving rise to lassitude.'

"Sir Douglas Galton says :—

'If the walls are to be warmed by the air admitted to the room, the temperature of the warmed air must be raised beyond what is either comfortable or healthy for breathing, and thus, if you obtain your heat by warmed air alone admitted direct to the room, discomfort in one form or the other can with difficulty be avoided.'

"Professor Corfield says :—

'Heating should be done by means of radiant heat, and not by means of air previously warmed. If air was previously warmed it would lose a portion of its oxygen, and if we got air short of oxygen we had to breathe a greater number of times to supply the required amount, and that meant more effort.'

"M. Emil Trélat, the highest authority in France, declares that :—

'The solution of the problem of heating dwellings had absolutely no connection with that of their ventilation.'

Prof. Shaw
uses a strong
adjective in
connection
with
"Plenum"
Ventilation.

Prof. Shaw
approves the
"freshness"
secured with
Natural
Ventilation.

Complaints
of "oppression"
and
"lassitude"
with the
"Plenum"
system.

Sir Douglas
Galton con-
demns hot-
air heating.

Prof. Corfield
condemns
hot-air
supply.

" Mr. Aston Webb, R.A., President of the Royal Institute of British Architects, has said, at a meeting of the Institute, that a building should be heated independently of the warmed fresh-air supply, with which alone, according to not only his own experience, but also that of one of the highest authorities on the subject, Mr. Phipson, ' It was impossible to properly warm a chamber.' "

President of the Royal Institute of British Architects says hot-air heating is " impossible."

" An eminent American engineer attributes the premature loss by Americans of the freshness and bloom of their youth to the enervating effects of the hot-air systems of heating and ventilating used in the United States, and which he says are being discarded for ' less pernicious methods.' "

" In connection with this, Professor R. H. Smith says :— ' A most instructive historical fact is the present gradual abandonment in the States and Canada of the hot-air system, which was for so long popular, in favour of hot-water pipe and other " radiator " warming.' "

Prof. Smith on abandonment of hot-air system in the States and Canada.

" To return to Professor Shaw's remark as to want of control with natural ventilation, this may be correct so far as open windows are concerned, and with which many people ignorantly confound a natural system ; they are, however, very different. What Professor Shaw said most certainly cannot apply to *scientific* natural ventilation, which is under complete control at all times ; so much so, indeed, that with it the temperature of any part of a room can be varied as desired at any time of the year, while the air supply is not overheated or deteriorated, as with mechanical systems, but is always fresh and pure, being filtered and cleansed and temperately warmed in cold weather, and cooled in summer as required. There are no draughts and no stagnation, and it is in continuous operation day and night—in the closest day in summer, and the muggiest day in winter—and this is efficiently effected even when there is seemingly no ' wind ' upon which natural ventilation is erroneously supposed by those who do not understand it to be entirely dependent, though nothing is further from the case. Parkes says :—

Natural Ventilation always in operation and under complete control.

' Incessant movement of the air is a law of Nature ; we have only to allow the air in our cities and dwellings to take share in this constant change, and ventilation will go on uninterruptedly without our care. In this country, and, indeed, in most countries, even comparative quiescence of the air for more than a few hours is scarcely known. Air is called " still " when it is really moving one or one and a half miles an hour. Advantage, therefore, can be taken of this aspirating power of the wind to cause a movement of the air up a tube.' "

Laws of Natural Ventilation.

" This is corroborated by another high authority, Dr. John

Hayward, whose publications on ventilation are standard works, and who says :—

Natural laws of atmospheric pressure and expansion by heat.

‘ That efficient ventilation can ever be automatic and costless may, perhaps, appear absurd ; it is, however, not so absurd as it may appear. This will be evident by reference to the natural laws of atmospheric pressure, and of its expansion by heat.

Natural Ventilation preferred to Artificial.

‘ If, therefore, the inlets and outlets be properly proportioned and open, the ordinary atmospheric pressure will carry on the ventilation quite efficiently, and the whole hospital will be kept fresh and comfortable by the natural forces alone. There is no fear that the speed will not be enough to keep up efficient ventilation—it is more likely to be too great ; but there need be no fear of its being too great, because it is completely under control, and can be regulated to any rate desired by the valves at the ward inlets and outlets. Natural ventilation is certainly much to be preferred to any and every artificial system, whether on the “Plenum ” or vacuum principle, and it is, of course, much less complicated. It is, indeed, comparative simplicity itself. It also involves very little original outlay and comparatively no permanent cost for maintenance. Whereas all artificial systems involve costly original plant of machinery, as well as heavy permanent expense for maintenance in engines, engineers, fuel, etc., and with all they cannot be made as efficient or nearly so pleasant and healthy in operation.’

“ Houghton says :—

Science and Natural Ventilation.

‘ Science proves that there is not a moment of time but when there is a movement of the air, and that this movement properly utilised is sufficient at all times to change the air in a building and secure ventilation.’

“ Surgeon-General Sir Thomas Crawford, whose name is so well known in connection with all questions of hygiene, says :—

‘ My experience of the process of forcing air into buildings is not in its favour. The only safe and sound means for the supply of air is the natural one of obtaining it from a pure source in a free and natural flow.’

French evidence against Artificial and in favour of Natural Ventilation.

“ A distinguished Paris surgeon, Dr. Le Fort, published a report on Hospital Hygiene. He there compares the mortality in London hospitals with that of the Paris hospitals, very much to the disadvantage of the latter, and professes himself decidedly in favour of the natural means of ventilation adopted in London to the artificial systems in vogue in some Paris hospitals. But he says, ‘ One need not go to England to

search for means of comparison between the two systems ; for the two hospitals in Paris where the mortality is greatest are precisely those in which artificial ventilation is employed.'

" With scientific natural ventilation are utilised the powerful natural forces which are as constant as gravity, and provide a never-failing motive power to ventilate a building. It must be confessed, however, that the reputation of natural ventilation has suffered a good deal from the abortive attempts of ignorant persons having little or no acquaintance with either the science or the practice of ventilation, and by the employment of so-called ventilating apparatus of crude and unscientific construction."

Natural forces provide a motive power as constant as gravity.

" De Chaumont says:—

' It is essential to the success of a natural system of ventilation that both the outlet and inlet ventilators be of correct construction and skilfully applied. Where this is not observed, failure generally ensues with this form of ventilation.'

Essential to the success of a natural system.

" As evidence that natural ventilation correctly applied is thoroughly efficient, it need only be mentioned that one system (Boyle's) has, it is stated, been successfully employed in over 100,000 buildings in this country, and twice as many abroad.

" As the ventilation of the Houses of Parliament is under review, it is interesting to note that Lord Clifford, member of the House of Lords Committee on Hospitals, says that with this system (Boyle's), ' the ventilation seems to be perfect,' and as representing the House of Commons, the Right Hon. C. Seale-Hayne, M.P., ' I believe it to be absolutely the best system of airing a building that is known to sanitary science.'

With a natural system the Ventilation seems to be perfect.

" The inefficiency of the extraction and propulsion fans employed in the House of Commons, as described in the Committee's report, and the draughts complained of, seem to be inherent and ineradicable features of these appliances.

" The following extracts from the notes on the evidence are instructive :—

Inefficiency of fans.

' You say that the chairman and other members of the committees have complained of the draught caused by the fans ? —I had in my mind one honourable Member in particular ; the chairman in the police and sanitary committee-room stops the fan immediately he comes into the room.'

' Numerous observations made as regards the percentage of carbonic acid in the air of the committee-rooms under different conditions as to the number of persons

present, and whether one or two fans were in operation ; results not satisfactory.'

Fans not
satisfactory.

' Common experience of many Members that the air of the Chamber lacks freshness and is productive of a lassitude which interferes with the due performance of their duties.'

' Result under the present system that a very large proportion of the vitiated air remains in circulation.'

' Lassitude and exhaustion due to the bad quality of the air.'

' Improved regulations and arrangements required so as to obviate the great draughts sometimes experienced where the Members sit.'

Fans
condemned.

' General condemnation of the principle of extracting air from buildings by fans.'

" Another report says :—

' The application of the electric fan has, up to now, done little more than substitute a thorough draught, the which of all discomforts an Englishman will least tolerate. In the circulars of ventilating engineers you find the statement that their particular fan will renew the air of a room so many times—say six times—per hour. This statement is not true. What is true is that sufficient air is extracted whose volume would fill the room six times per hour, and that, of course, an equal quantity of air is sucked into the room ; but to infer that all the vitiated air, or half, or a third, of it had been disturbed and drawn off is to come to a false conclusion. I know a large smoke-room in town where a fan is at work on one side of the room where it is so draughty no one will sit. At the other side of the room it is suffocatingly hot, with no apparent movement of air.'

Draughts
and asphyxi-
ation with
fans.

" It would appear from all this that with fan ventilation it is merely a choice of two evils—between being blown out of a room or asphyxiated.

" An expert witness, giving evidence before the Committee on the ' Plenum ' system, said :—

' The great disadvantage of the system is that the breath which has ascended must be brought down and rebreathed by those who are present.'

Disadvan-
tages of
" Plenum "
Ventilation.

" At the Congress of the Institute of Public Health it was stated by a delegate from the Glasgow School Board that :—

' The artificial system (" Plenum ") had been found there to be so unsatisfactory that it was not now introduced into any of the new schools.'

" It is also stated that this system had proved so unsatisfactory in the Aberdeen schools that further measures were

introduced. The failure of mechanical ventilation at the Town Hall, Birmingham, would likewise seem to be a source of considerable dissatisfaction, a deputation of citizens having been appointed to protest against it as a danger to the public health, the draughts being intolerable. The Central Criminal Courts at the Old Bailey may also be mentioned as examples of the inefficiency and unhealthiness of mechanical ventilation by fans, both extraction and propulsion being used.

Mechanical Ventilation a danger to health.

"Tables of phenomenal air velocities and analysis by mechanical means are so many meaningless formulas before facts like these.

Air volumes and analysis meaningless formulas.

"As has been stated, the P'enum system is of American origin; but is now being generally abandoned in that country in favour of natural, less costly, and more effective methods. In a recent United States Government report its grave danger is pointed out, and its enormous cost declared to be unwarrantable.

"Mr. Addison Hutton, architect, in a lecture on 'The Planning of Hospitals,' recently delivered before the Architectural Department of the University of Pennsylvania, made a most significant statement, as the result of his investigations throughout the States, that with respect to ventilation 'one point worth noting in regard to this was, doctors, for a wonder, do not differ in their recommendations for top ventilation, or what is termed ridge or natural ventilation.'

The medical profession of the United States recommend Natural Ventilation.

"When the entire medical profession of a whole continent are in agreement as to the superiority of natural over artificial ventilation, there can be very little doubt about it.

"'Plenum' ventilation is also falling into disuse on the Continent, and many leading medical men have publicly expressed their disapproval of it. Dr. Walthers, the eminent head of the famous consumption sanatorium at Nordach, Germany, denounces it as being dangerous to health, and a positive hindrance to the recovery of the sick.

"A well known London architect, Mr. Alfred Frampton, says it is 'a menace to health.' and 'its danger cannot be exaggerated.' Whilst another authority says:—

'It is universally condemned by scientific authorities as most pernicious, contrary to the laws of nature, and—from causes which are well known—fatal to health, insidiously sowing the seeds of disease.'

"Plenum" Ventilation condemned.

"There is no controverting the fact that the 'Plenum' system is fundamentally wrong. It is unscientific in principle, opposed to all the laws that govern ventilation. is contrary to common sense, and 'a menace to health.' It is, indeed, as the Royal Commissioner on ventilation has said, 'a pernicious

A pernicious and an abominable system.

and an abominable system.' No care nor attention, however skilled or assiduous, nor adjustment of machinery or detail, could ever make it efficient and satisfactory; indeed, certain of its advocates seem to realise its utter hopelessness as applied, and now require that buildings should be specially designed to suit it, and that they should be *without windows*.

A naive proposition.

"All this merely goes to show to what desperate straits 'Plenum' ventilation is reduced, and the very naive proposition that architects should make their designs subservient to the ventilation system is hardly one that will commend itself to the architectural profession as a body.

Singularly pathetic.

"As evidence of how hopeless the members of the Select Committee would seem to be with regard to these artificial systems, it is singularly pathetic that almost the last question put to Professor Shaw, that 'an open window is the best thing you can get, but you cannot always have it?' to which Professor Shaw replied in the affirmative, adding that the defects of open-window ventilation 'had not yet been avoided.'

Lord Kelvin testifies in favour of Natural Ventilation.

"The value of natural ventilation has been eloquently testified to by the distinguished doyen of scientists, Lord Kelvin, in a report to Mr. Robert Boyle, who is probably the highest living authority on the subject, and whose inventions have solved so many problems in sanitary science, particularly those perfected in collaboration with the Right Honourable Acton Smee Ayrton, when First Commissioner of Works, Sir Charles Siemens, F.R.S., and Sir John Marshall, late President of the Royal College of Surgeons, these eminent savants being earnest workers in the cause of pure air and natural ventilation. The £100,000 gift recently made by Mr. Boyle to promote the teaching of the principles of natural ventilation in the schools and colleges of the Empire should also go far to disseminate a more practical and widespread knowledge of that important science.

£100,000 gift to promote teaching of principles of Natural Ventilation.

Prof. Corfield expounds the advantages of Natural and fallacy of Mechanical Ventilation.

"Dr. Corfield, Professor of Hygiene and Public Health, University College, London, and founder of the International Society of Hygiene and Demography, has consistently taught the advantages of natural ventilation, and the fallacy of artificial methods, particularly mechanical.

Prof. Wade states that Ventilation can only be successfully achieved by Natural means.

"Professor Wade, of Oxford University, lecturer on hygiene, also reports as the results of his investigations:—

'Ventilation can only be successfully accomplished at all times when it is effected without assistance from mechanical or artificial contrivances. However perfect these may appear, they can never achieve results superior to those insured by judicious and intelligent adaptation of natural means; and they necessarily suffer from the very serious

disadvantage that they are liable to interruption without warning, and with possibly disastrous consequences.'

'It seems plain from all this that Select Committees on the ventilation of the Houses of Parliament can never hope to succeed with artificial methods, and the use of fans, the employment of which has so far resulted in such 'disastrous consequences,' the Members, according to the following extracts from the report, being literally poisoned :—

Members
poisoned
with
Mechanical
Ventilation.

'Bad air shown by the examinations in the case of the Committee-rooms; limited effect of the fans....'

'Strong complaints as to the very injurious effect upon the health of witnesses and counsel through the bad air in the Committee-rooms....'

'Strong protests by Parliamentary counsel and by engineers and other witnesses as to the insanitary condition of the rooms, a memorial having been presented on the subject, several instances of serious injury to health from blood poisoning.'

Strong pro-
tests as to
insanitary
results of
Artificial
Ventilation.

'The great cost incurred in these endless and abortive experiments with mechanical systems is also a very serious matter, and the public, that has to pay, will doubtless heartily agree with Sir Henry Burdett when he says :—

'The really important point to be kept in view in regard to ventilation is that before any system depending upon mechanical contrivances can be pronounced worthy of adoption, it must be demonstrated beyond dispute that it is not only as good as ordinary methods, but appreciably better. For nothing but a substantial improvement would justify the largely increased cost, both of construction and maintenance, necessarily consequent on the adoption of mechanical ventilation.'

Sir Henry
Burdett's
warning re
Mechanical
Ventilation.

'In this connection Mr. Alfred Frampton says :—

'As it is now generally admitted that mechanical ventilation is not found to be more efficient than ordinary and less expensive methods, the unanswerable objection to its employment is its enormous and unnecessary expense.'''

Unnecessary
expense of
Mechanical
Ventilation.

